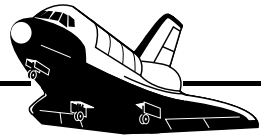




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# Mission Highlights STS-48



## Space Shuttle *Discovery*

**September 12-18, 1991**

**Commander:**

John O. Creighton, Capt., USN

**Pilot:**

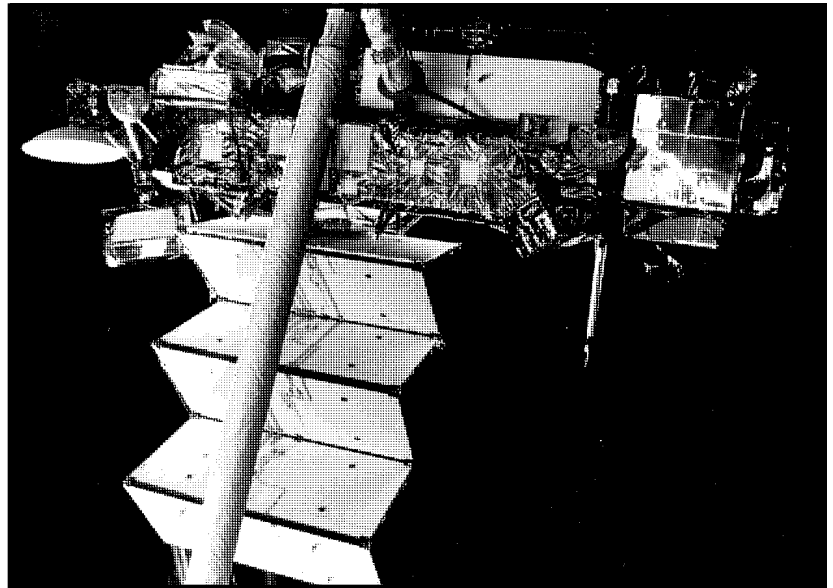
Kenneth S. Reightler, Cmdr., USN

**Mission Specialists:**

James F. Buchli, Col., USMC

Mark N. Brown, Col., USAF

Charles D. Gemar, LTC., USA



While still held to *Discovery* by the remote manipulator system arm, the UARS spacecraft deploys its single solar array.

## Major Mission Accomplishments

- Successfully deployed the Upper Atmosphere Research Satellite into a 570-kilometer-high orbit. The launch of this satellite signals the start of a multiyear research mission to understand the environment of planet Earth.
- Conducted 11 hours of tests for the Mid-deck 0-Gravity Dynamics Experiment (Massachusetts Institute of Technology Space Engineering Research Center). Data for this experiment will permit space station designers to develop accurate computer models of space station structures and fluid transfer dynamics.
- Conducted a variety of scientific and technologic experiments including Investigations into Polymer Membrane Processing (Batelle Advanced Materials Center, Columbus, Ohio), Protein Crystal Growth II (Marshall Space Flight Center), and the Cosmic Radiation Effects and Activation Monitor (Department of Defense).
- Collected more than 240 digital images with an electronic still camera and transmitted 200 of those images to Earth.
- Collected many Earth resources photographs of the Southern Hemisphere including photos of the Ross Ice Shelf on the continent of Antarctica.
- Performed orbital maneuvers to avoid a possible collision with a Soviet rocket booster in orbit.

The thirteenth flight of the Space Shuttle *Discovery* marked the beginning of a new mission for NASA that may prove essential to the future well-being of Earth's environment. The successful deployment, by the STS-48 crew, of the Upper Atmosphere Research Satellite (UARS) is the beginning of the much anticipated Mission to Planet Earth. Mission to Planet Earth is a multisatellite program to study our planet from space. Monitoring and understanding environmental problems, such as global warming and ozone depletion, will require coordinated data-gathering by ground laboratories, instrumented balloons, aircraft, and Earth satellites. UARS is the beginning of that effort.

*Discovery's* crew of five deployed UARS during their third day in orbit. The 6,554-kilogram spacecraft, filling over one-half of *Discovery's* payload bay, was lifted out of the bay by the orbiter's remote manipulator system arm. The satellite's single solar array, a panel covered with solar cells that convert sunlight into electrical power, was extended while still attached to the arm. After establishing a communications link between UARS and its ground controllers through the Tracking Data and Relay Satellite, the spacecraft was released into a 570-kilometer-high orbit inclined 57 degrees to Earth's equator.

From its high vantage, UARS began transmitting important data, even as it underwent its month-long checkout period. One of the main purposes of UARS is to map and monitor global ozone in the upper atmosphere. Ozone molecules consisting of three atoms of oxygen each, block much of the Sun's harmful ultraviolet radiation. Without ozone, radiation would be free to reach Earth's surface, constituting a significant health risk to humans and



STS-48 crew members gather on the middeck of *Discovery*. Mission commander John O. Creighton is at the center. Clockwise from the lower left are pilot Kenneth S. Reightler and mission specialists Mark N. Brown, Charles D. Gemar, and James F. Buchli.

endangering food crops.

Recent aircraft and satellite studies have indicated that human-made chemicals can migrate into the upper atmosphere and destroy ozone. Early results from UARS's microwave limb sounder instrument, one of 10 instruments on the satellite, appear to confirm existing research. The instrument is providing scientists with a three-dimensional global map of ozone in the upper atmosphere and of the ozone-destroying chemical chlorine monoxide.

One of the major investigations of the STS-48 flight was the Middeck 0-Gravity Dynamics Experiment (MODE). The purpose of the experiment was to study the behavior of space structures and fluids in the microgravity environment of Earth orbit. In one phase of the experiment, crew members constructed four different models, each up to two meters in length, of truss beams similar in design to those that are being developed for Space Station *Freedom*. Beam sections were instrumented with strain gauges and other sensors so that precisely controlled stresses applied to the structure could be measured. The stresses were applied by a vibrator motor mounted on the truss structure. Data gathered

on the dynamics and harmonics of the structure will enable space station designers to construct accurate computer models of how large-scale space station structures will respond to forces experienced in Earth orbit.

The other phase of MODE involved the dynamics of fluids in plastic cylinders about the size of soft drink cans. Two cylinders were used, one containing water and the other silicon oil. Using a vibrator device, investigators hope to improve understanding of the frequency and amplitude dynamics that take place when liquids, such as fuel, are moved within spacecraft.

On flight day four, mission controllers determined, from data gathered by spacecraft-tracking stations around the world, that the body of a Soviet Cosmos 955 upper stage booster would pass *Discovery* within a distance of 2.2 kilometers. This unplanned passage would violate NASA safety criteria for orbital operations. *Discovery's* crew fired its engines to increase the passage distance to just over 16 kilometers. The orbital adjustment is believed to be the first time a manned spacecraft has been moved to avoid a potential collision.

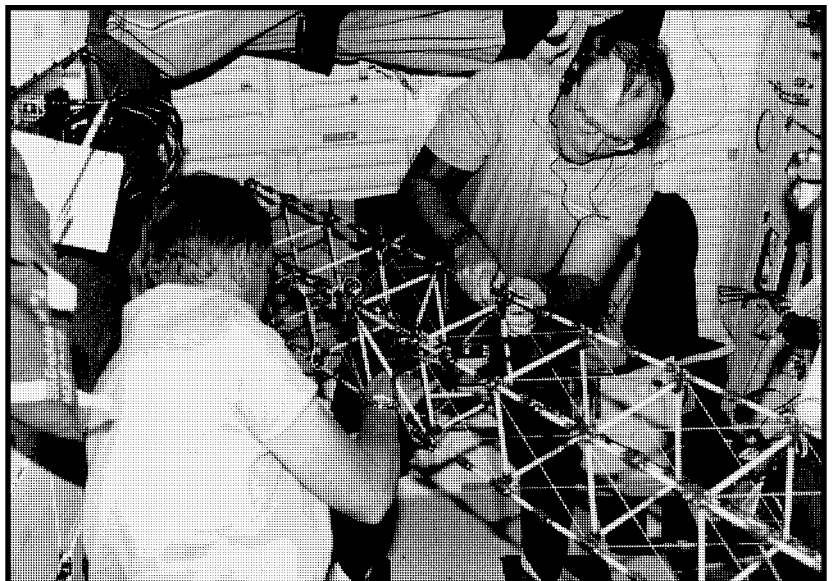
As with all Space Shuttle missions, crew members of STS-48 took whatever opportunities their schedule permitted to observe and photograph Earth from space. The high inclination of their orbit, 57 degrees with respect to the equator, permitted them to fly over much of Earth's surface, both land and oceans. Using standard color and color infrared films, the crew took excellent photographs of urban, rural, and agricultural land-use patterns. Dramatic views of the Ross Ice Shelf of Antarctica, showing ice movements and pressure ridge patterns, were collected, along with pictures of a tabular iceberg (broad, flat top) over 2,100 square kilometers in area.

Spaceflight veterans on the STS-48 crew reported that the middle latitudes of Earth (30 degrees north to

30 degrees south) were hazier than they had been on their previous flights at the same time of the year. The STS-48 mission flew during the prime slash-and-burn agricultural season in the Amazon basin. Visibility in this region was greatly restricted by smoke. Oil well fires in Kuwait and ash discharges from Mt. Pinatubo in the Philippines also contributed to visibility problems.

In addition to the regular photographic activities conducted by the STS-48 crew, an electronic still camera was tested. This new photographic technology captured and digitized black-and-white images with a resolution approaching film quality. Crew members took 240 images with the system, 200 of which were transmitted via radio directly to mission control. The electronic still camera permitted electronic cropping and digital enhancement of images to improve their quality.

Other activities of the STS-48 crew included follow-up experiments, from previous Shuttle missions, including protein crystal-growth, polymer-membrane processing, and radiation monitoring.



Crew members Mark N. Brown (left) and James F. Buchli (right) assemble a model of a space station for testing in the Middeck 0-Gravity Dynamics Experiment.

## Mission Facts

**Orbiter:** *Discovery*

**Mission Dates:** September 12-18, 1991

**Commander:** John O. Creighton, Capt., USN

**Pilot:** Kenneth S. Reightler, Cmdr., USN

**Mission Specialist:** James F. Buchli, Col., USMC

**Mission Specialist:** Mark N. Brown, Col., USAF

**Mission Specialist:** Charles D. Gernar, LTC., USA

**Mission Duration:** 5 days, 8 hours, 27 minutes

**Kilometers Traveled:** 3,530,273

**Orbital Inclination:** 57 degrees

**Orbits of Earth:** 81

**Orbital Altitude:** 570 km

**Payload Weight Up:** 7,882 kg

**Orbiter Landing Weight:** 87,503 kg

**Landed:** Runway 22, Edwards AFB

**Payloads and Experiments:**

Upper Atmosphere Research Satellite

Ascent Particle Monitor

Radiation Monitoring Experiment III

Protein Crystal Growth II Block 1

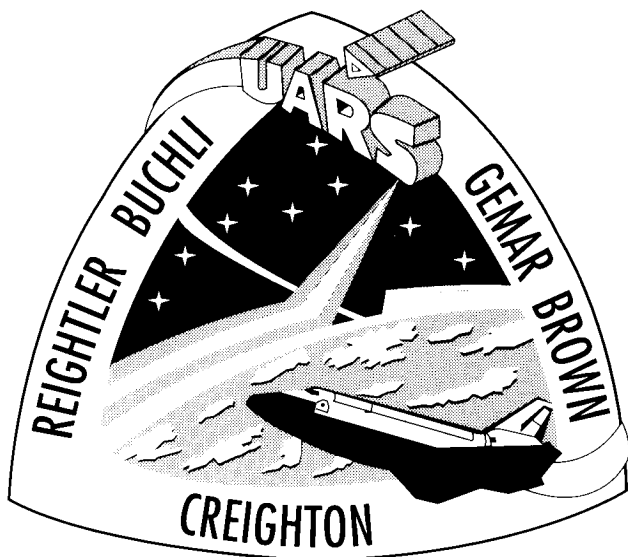
Middeck O-Gravity Dynamics Experiment

Investigations into Polymer Membrane Processing

Physiological and Anatomical Rodent Experiment

Shuttle Activation Monitor

Cosmic Radiation Effects and Activation Monitor



STS-48 Crew Patch

## Crew Biographies

**John O. Creighton (Capt., USN).** John Creighton, from Seattle, Washington, earned a Bachelor of Science from the United States Naval Academy and a Master of Science in administration of science and technology from George Washington University. Creighton has been a naval carrier pilot and a test pilot. He was the project development officer for the F-14 engine and a member of the first F-14 squadron. He has flown in space twice previously, on the STS-51G mission (pilot) and on the STS-36 mission (commander).

**Kenneth S. Reightler, Jr. (Cmdr., USN).** Kenneth Reightler was born in Patuxent River, Maryland but considers Virginia Beach, Virginia his home. He earned a Bachelor of Science in aerospace engineering from the United States Naval Academy, a Master of Science in aeronautical engineering from the Naval Postgraduate School, and a master's in systems management from the University of Southern California. Reightler is a naval aviator and test pilot, and before being selected as an astronaut, served as the Chief Flight Systems Instructor at the U.S. Naval Test Pilot School. This was his first spaceflight.

**Charles D. Gernar (LTC, USA).** Charles Gernar was born in Yankton, South Dakota but considers Scotland, South Dakota his hometown. He received a Bachelor of Science in engineering from the United States Military Academy. Upon graduation, he attended both the Army rotary wing and multi-engine fixed wing aviation course. Before joining NASA, Gernar served in a number of aviation assignments with the 24th Infantry Division and Hunter Army Airfield. Gernar flew as a mission specialist on the STS-38 mission.

**James F. Buchli (Col., USMC).** James Buchli was born in New Rockford, North Dakota. He earned a Bachelor of Science in aeronautical engineering from the Naval Academy and a Master of Science in aeronautical engineering systems from the University of West Florida. Buchli has served as a platoon commander, company commander, and executive officer in Vietnam before earning his wings as a naval fight officer. He flew in space as a mission specialist three other times, on the STS-51C, STS-61A, and STS-29 missions.

**Mark N. Brown (Col., USAF).** Mark Brown was born in Valparaiso, Indiana. He earned a Bachelor of Science in aeronautical and astronautical engineering from Purdue University and a Master of Science in astronautical engineering from the Air Force Institute of Technology. Before joining NASA, Brown served in a fighter interceptor squadron and at the Air Force Institute of Technology. At NASA, Brown worked as a flight activities officer in Mission Control. He flew in space as a mission specialist on the STS-28 mission.